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ABSTRACT

This document contains four papers from a symposium on technology in human resource development (HRD). "COBRA, an Electronic Performance Support System for the Analysis of Jobs and Tasks" (Theo J. Bastiaens) is described as an integrated computerized environment that provides tools, information, advice, and training to help employees do their jobs. "Perceived Barriers to Learning over the Internet" (James J. Kirk, Harold Shoemaker) reports on a study of 764 individuals' perceptions analyzed by age, gender, position, organization size, computer knowledge, and prior online experience. Results reported in "E-Mail Mentoring: Boundary Spanning for the Distance Learner" (Toni Powell, Betty Hubshman) show that mentoring enabled graduate students to interpret the online system more accurately and span transactional distance. "An Organizing Scheme for the Uses of Software Technology in HRD" (Carson R. Arnett) presents a taxonomy outlining purposes for the following stages of HRD software use: analysis, design, development, implementation, evaluation, and management. (KC)

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20 **Technology in HRD**

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COBRA, an Electronic Performance Support System for the Analysis of Jobs and Tasks

Theo J. Bastiaens, University of Twente, Enschede, The Netherlands

Perceived Barriers to Learning Over the Internet

James J. Kirk, Western Carolina University

Harold Shoemaker, Indiana State University

E-Mail Mentoring: Boundary Spanning for the Distance Learner

Toni Powell, Barry University

Betty Hubschman, Barry University

An Organizing Scheme for the Uses of Software Technology in HRD

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AHRD

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T Bastiaens T Powell
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Oak Brook, IL

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COBRA, an Electronic Performance Support System for the analysis of jobs and tasks

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In this research project the concept of "Electronic Performance Support Systems" will be introduced. An Electronic Performance Support System (EPSS) is an integrated computerised environment that supports and occasionally monitors employees while doing their jobs. In general an EPSS contains the following for components: tools (to perform an job), information (needed to do the job correctly), advice (for the difficult parts of the job) and training (to extend the employees knowledge and skills). In this study the effectiveness of an EPSS for instructional designers is reported.

Advances in information and communication technology have led to the introduction of new technologies in the area of training, such as Computer-Based Training (CBT), multimedia, CD-I and CD-ROM. Various forms of computer technology have been used as a training medium, with varying degrees of success. The most recent developments are based in part on ideas relating to the concept of 'the learning organization'. The benefits that computers offer, integrating working and learning with new technology, in the form of Electronic Performance Support Systems (EPSS), form an important point of departure here. EPSS is principally intended for employees who depend on a computer for carrying out their job. Apart from performing the usual tasks with programs that process data (tools), the computer also provides the employee just-in-time with information, advice and training (see figure 1).

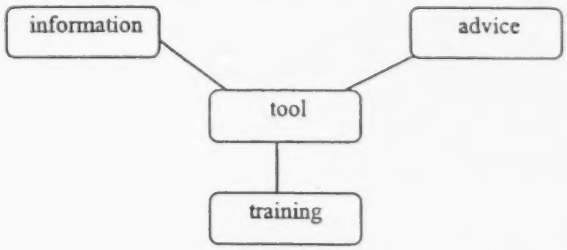

Figure 1

A diagram of the components of an EPSS

The potential advantages of learning with EPSS are considered to be a more active learning process, more concrete forms of learning, an increase in the transfer of what has been learned to the workplace and a reduction in learning time (Gery, 1989, 1992; Raybould, 1990, 1991). The potential advantages of working with EPSS relate to the higher quality and higher productivity that may be achieved.

Problem Statement

Although in the literature opinions on EPSS are on the whole positive, some objections are raised

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that deserve closer examination. Learning at the moment that this is necessary (just-in-time) ensures that employees are trained in small units of subject matter. This may well be a disadvantage when training novices, who appear to benefit from having an overall picture of the subject matter, which may serve as a stepping stone to new knowledge.
Another problem is a very demanding working environment (pressure of work), where employees do not have time to look up information, and thus have no time to learn.

The long-term effect of using EPSS may be that employees will come to rely on the computer and, consequently, no longer learn actively themselves. Employees will then get out of the habit of acquiring knowledge and skills of their own, because this would no longer be necessary.

Research Questions

This study focuses on EPS-systems, which may in theory possess the advantages for working and learning described above. In the study, instructional designers were provided with an EPSS and research was carried out into the effectiveness of the EPSS compared with traditional methods of working and learning.

The questions we try to answer are the following:

- What are the needs of instructional designers to fulfil by EPSS when they are executing a job or task analysis ?
- What are the effects of an EPSS on the information use?
- Do instructional designers who work with an EPSS perform better than instructional designers who work the traditional way?
- Does an EPSS have an effect on 'training'? Do people learn more (compared with an control group trained the traditional way)?
- What do employees like and what don't they like about EPSS?

Methodology

The general research question that will be discussed is as follows:

What is the effectiveness of learning and working with Electronic Performance Support Systems compared with traditional methods of training and working?

The reason for deciding to conduct this research lies in the fact that to date scarcely any empirical-analytical research has been carried out in the area of the effectiveness of EPSS. Both the advantages and disadvantages that are mentioned are therefore mainly of a hypothetical nature. It is relevant to analyze these expectations and to assess them on the basis of empirical research. Based on the problem exploration the following groups of relevant variables have been defined: working, learning, EPSS and environment. The relationship between the different variables is shown in figure 2.

In the study, attempts were made to develop an ideally typical EPSS to support training officers or instructional designers when carrying out job and task analyses. A comparison was made between working and learning with EPSS and working and learning in the traditional manner. The results of the summative evaluation were studied, as were the routing of users through the program and the use of various resources.

It would appear in a study of EPSS that many factors exert an influence. In business organizations in particular, external control over (intervening) variables is limited (Bastiaens, Nijhof & Abma, 1995; Bastiaens, Nijhof, Streumer & Abma, 1997). In this study, which took place at the University of Twente, attempts were made to stabilize factors. However, this was not a purely experimental design, since randomization was not possible.

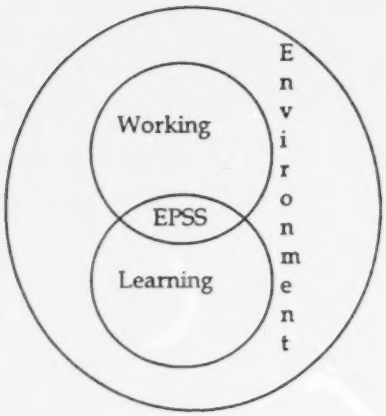

Figure 2: A diagram of the variables

As a result of the above obstructive factors, the research had a quasi-experimental design. This is a design that is often used in research, where control over the influence of external intervening variables cannot be complete, or where the researcher is working with an existing group classification. Table 1 represents the general design of the quasi-experimental study. It is a post-test-only design with non-equivalent groups. Due to practical reasons it was not possible to hold a pre-test.

Table 1

Basis for the study, the post-test-only design with non-equivalent groups

X1	O1	O2	O3
X2	O1	O2	O3

O1- post-test (learning outcomes)
O2- post-test (Questionnaire)
O3- post-test (performance)

X1- treatment 1
X2- treatment 2

In this project an EPSS was developed, formatively evaluated and revised. After that an summative evaluation was carried out in an quasi-experimental setting. During the evaluation the experimental group (n=14) was working and learning with the EPSS. The control group (n=12) was working and learning the traditional way (pen-paper based, classroom training).

After the treatment, data was collected by questionnaires. The outcomes of an assignment were reviewed by three curriculum experts and a learning test was taken. In the paper we try to give an answer on the research questions stated above.

The Theoretical Construct

The conceptual framework which included constructs has been extracted from an similar research project that was carried out earlier (Bastiaens, Nijhof, Streumer & Abma, 1995, 1997). The

constructs enclose the variables that exert an influence on the EPSS. Working , learning, treatment and background will have an effect. In table 2 we define our variables. Work, learning, information use and background are general constructs for every treatment. COBRA and Class are specific for the treatment. COBRA is the name of the EPSS program. COBRA provides information, advice and training to users while they are performing their tasks (e.g. develop a job- and task analysis). Class refers to the classroom instruction.

From the constructs variables are derived from which items are formulated. These items were used in questionnaires and given to the instructional designers.

Table 2: A list of constructs

Constructs	Variables
WORK	
Quality	Quality of the assignment
LEARNING	
Output learning	Learner results
COBRA	
Communication	Interface
Help	Experienced action
Training and support	Training, support
Pedagogical/didactic dimensions	Structure, experienced validity, co-operative learning
Effects	Self-confidence, problem solving, applicable
CLASS	
Training and support	Training, support
Pedagogical/didactic dimensions	Structure, experienced validity, co-operative learning
Effects	Self-confidence, problem solving, applicable
INFORMATION USE	
While working (on assignment)	Taking and using notes, articles
Acquire new information	procedural information, content
BACKGROUND	
Working attitude	Motivation, satisfaction
Performance	Independence
Knowledge, skills and attitude	Relevance for job
Way of learning	Processing, guidance, study conceptions, extrinsic, motives
Experience	study results

Results

When an opinion is given about the EPSS we consider the results of the experimental group (working and learning with COBRA) as representative. For an opinion on traditional working and learning we consider the control group (CLASS) as representative. The independence of the groups has to be assured in order to be able to use the data. We had to test the reliability of the items involved. The limit was 0.60 (Cronbach's alpha). The variables that were useful ($\alpha > .60$) are shown in table 3.

Table 3 shows no reliability for the constructs working, learning and information use. The quality for working was measured by the quality of an assignment and reviewed by three curriculum experts. The output of the learner was measured on a test and the information use was observed and the sources were counted.

First the independence of the two groups had to be tested on background. Two variables passed the limit of $\alpha > .60$. As a result working attitude ($\alpha = .75$) and way of learning ($\alpha = .70$) were tested. No significant difference was found on working attitude (Mann Whitney test, U= 64.5, $\overline{R}1=13.14$, $\overline{R}2=11.96$, $p > .05$). Also, no significant difference was found for the way of learning (Mann Whitney test, U= 47.7, $\overline{R}1=16.54$, $\overline{R}2=10.89$, $p > .05$). Although we also collected the data of the other

variables and interpret their means and standard deviations we will not go into detail and therefore leave this variables out of consideration in this paper. The conclusion from this tests are that there is no difference between the control and experimental group on background.

Table 3: The variables used and Cronbach's Alpha

Constructs	Variables	α
WORK		
Quality	Quality of the assignment	-
LEARNING		
Output learning	Learner results	-
COBRA		
Communication (.74)	Interface	.74
Help (<.60)	Experienced action	.59
Training and support (.68)	Training, support	.58,.85
Pedagogical/didactic dimensions (<.60)	Structure, experienced validity, co-operative learning	.27,.68, .80
Effects (<.60)	Self-confidence, problem solving, applicable	.53,.61 .27
CLASS		
Training and support (.77)	Training, support	.72,.58
Pedagogical/didactic dimensions (<.60)	Structure, experienced validity, co-operative learning	.26,.81 .72
Effects (<.60)	Self-confidence, problem solving, applicable	.53,.61 .27
INFORMATION USE		
While working (on assignment)	Taking and using notes, articles	-
Acquire new information	Procedural information, content	-
BACKGROUND		
Working attitude (.75)	Motivation, satisfaction	.43,.73
Performance (<.60)	Independence	.73
Knowledge, skills and attitude (<.60)	Relevance for job	.61,.23,.09
Way of learning (.70)	Processing, guidance, study conceptions, extrinsic, motives	.63,.44,.25 .62,.54
Experience	study results	-

Hypothesis Related to Learning. The reliable items were used to give an answer on the hypothesis. We also used the data from the learning test and the assignment. The hypothesis related to learning expected the experimental group (working and learning just-in-time with an EPSS) to have higher learner results. The learner results on the test (t-test, $t=2.71$, $df=24$, $p<.05$) showed us a significant difference between the two groups. It appeared that the control group (trained in a classroom) had higher learner results then the experimental group. The EPSS group didn't learn as much as the group trained in a classroom.

Hypothesis Related to Performing. When we looked at the performance the following hypothesis was stated; The quality of the assignment (performing a task analysis) from the experimental group is higher then the assignment of the control group. The end result of the assignment was reviewed by three curriculum experts. Table 4 shows the opinion of the experts and gives the mean scores and standard deviations per group.

Table 4: The score of the groups on the assignment

	Expert 1		Expert 2		Expert 3	
	M	s.d.	M	s.d.	M	s.d.
Control group	6.50	2.47	7.58	2.31	5.54	2.17

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Experimental group	15.43	1.99	15.43	1.99	13.68	2.52

The mean scores are significantly different. The experimental group with the EPSS has a higher score on the assignment. The t-test supports this (t= -10.07, df=24, p<.05). The quality of the assignment from the EPSS group is significantly better.

Hypothesis Related to the Time-on-task. It is expected that the time-on-task is less when working with an EPSS. The hypothesis is; the experimental group is spending less time on a learner test and on the assignment (while working) then the control group.

When we look at the time we see that the experimental group is spending more time on the learner test then the control group (M1=17.27, M2= 19.36, t-test, t=-.99, df=16.10, p>.05). On the other hand the control group is spending more time on the assignment (M1=107.27, M2=97.00, t-test, t=1.13, df=23, p>.05). Both differences are not statistically significant.

Hypothesis Related to Training and Support. The hypothesis on training and support is that the users of the EPSS were more satisfied about the training component of the EPSS and about the on-the-job support of the EPSS than the control group is about the traditional way of training and support. The mean rank of the control group is 15.21 and the mean rank of the experimental group is 12.04. It appears that there is no significant difference between the two groups (Mann-Whitney test, U=73.5, p>.05). Both groups are equally satisfied about the support and training facilities of their treatment.

Monitoring of the Working Process

To get an insight in the use of all the facilities the EPSS provides, we build in a monitoring function. The working process of the EPSS users (n=13) is translated to graphs and mutually compared. Figure 3 is an example of a route.

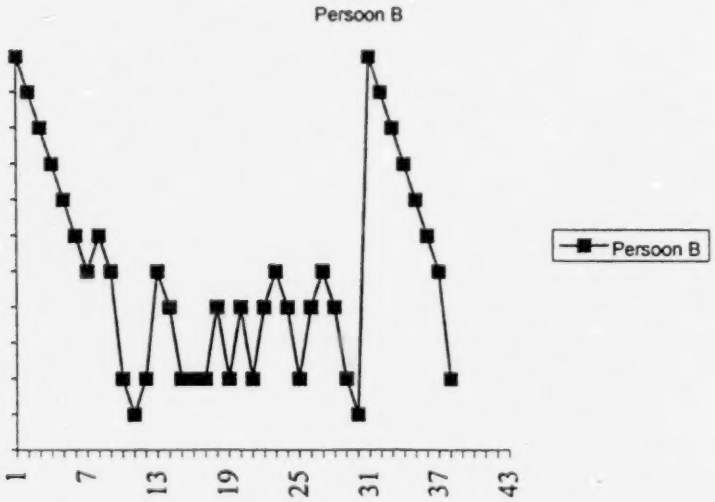

Figure 3: A way of working with the EPSS

It is surprising that when we look at the data of the thirteen users we see that the help component is used 58 times on 886 actions. That is a mean score of 4.46 times per user (s.d.=3.57). The CBT or learning component is used 16 times on 886 actions. That is a mean score of 1.23 times per user (s.d.= 2.05). We can state that these components are not used very much.

Conclusions

The effects of working with EPSS In the study the EPSS contained TOOL, INFORMATION and CBT components. The EPSS group in this study produced a significantly better end product than the control group. It is assumed that this can be ascribed to the structured EPSS environment, in which the tasks to be performed were split up into sub-tasks. A task is less complex once it can be divided into parts. As far as time is concerned, the group working with EPSS did not prove to be significantly faster in completing the assignment. Although many tasks were performed automatically by the computer, no gain in time was recorded. This can probably be explained by the fact that the EPSS group still had to look up all the information itself while working and, at the same time, had to learn how to operate the EPSS, which slowed down job performance. The control group, which had already received training preceding the assignment, was able to get down to work immediately. If one looks at the support provided, then the EPSS group appeared to have made very little use of the CBT and INFORMATION components. When one of the two components was indeed consulted, this occurred during specific parts of the program that were regarded as difficult (when the user encountered a problem).

Effects of learning with EPSS The results of the effectiveness study revealed that the control group that had received whole-class training scored significantly higher in a test of their knowledge than the group that had been learning with EPSS. Contrary to expectations, EPSS proved not to produce higher learning outcomes. Quite the reverse, in fact. The learning outcomes of the control and experimental groups indicated that 'learning with EPSS' is less effective than 'learning in the traditional manner'. One reason for these disappointing results from the EPSS group may well be the scant use of the INFORMATION and CBT component in the EPSS. Moreover, the monitoring process revealed that the experimental group only consulted the support sources when a problem was encountered in practice, which is, in fact, the underlying principle of EPSS. These test subjects used the support very little in preparation for an action or to become specifically better-informed. When learning with EPSS, there is probably a focused learning process of skills where solving the problem, as it is perceived at that moment, plays a major role.

Educational and Scientific Implications

The last four years we have been working on several cases in the field of performance support (Bastiaens, Nijhof & Abma 1995; Bastiaens, Nijhof, Streumer & Abma (1997). In the field of EPSS a lot has been stated but less have been proven. Our research projects show us that EPSS does not always fulfil the expectations. In general, the following may be said about training, working and the use of EPSS.

As far as training with EPSS is concerned, there are found to be disadvantages linked to concepts such as just-in-time learning and minimal training on-the-job, such as postponing the learning process and a loss of the overall picture.

As regards working, it becomes clear that an EPSS does not automatically produce an increase in productivity. The greatest advantage of computer support while working proves for the time being to be in the automation of tasks. The computer can easily take over simple, routine or boring tasks.

As far as the use of EPSS is concerned, it appears that test subjects set about their work in a variety of ways. In general, there is a tendency for very little use to be made of inbuilt support, however comprehensive or exhaustive the help function or the CBT may be. In addition, it appears that eliminating intervention or support from other people is not regarded as desirable by the users of EPSS. On the contrary, human intervention by colleagues, for example, is very much appreciated.

In our research we try to look more careful and fundamentally to these electronical environments.

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Perceived Barriers To Learning Over The Internet

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This study explored differences in perceived barriers to learning over the Internet held by 764 individuals employed at 38 community colleges. Differences in perceived barriers were examined with respect to age, gender, career position, size of employing institution, knowledge of computers, knowledge of the World-Wide-Web, and prior experience with on-line courses. The findings hold implications for trainers, educators, and organizations interested in offering training modules and courses on-line over the Internet.

This research explores perceived barriers to learning over the Internet. Currently available on the graphical area of the Internet known as the World-Wide-Web are a variety of kindergarten through twelfth-grade courses and college degrees (Lord, 1995; Milone, 1997). Examples of such offerings include a four-year high school curriculum from the Department of Distance Education at the University of Nebraska (http://www.concord.org/proj-vhs.html), an Internet Academy for Home Schoolers at the Federal Way School District 210 (http://www.fwsd.wednet.edu/), and college degrees from the Open University (http://www.open.ac.uk/) and Western Governors University (http://www.westgov.org/smart/vu/vu.html). Accompanying the increase in on-line courses has come a growth in on-line clearinghouses such as the World Lecture Hall (http://wwwhost.cc.utexas.edu/world/instruction/index.html) and the Globewide Network Academy (http://www.gnacademy.org:8001/uu-gna/index.html). These web sites provide lists and/or searchable databases of on-line course offerings.

With instructors and students at different locations, on-line courses via the Internet can be considered a form of "distance instruction" (Dede, 1995; Kerka, 1996). A number of studies of on-line courses have generally found this form of instruction to be effective for highly motivated students (Hilz, 1990; Lyons, 1995; Moore & Thompson, 1990; Tissue et al.l, 1996). On-line courses have also been shown to be cost-effective (Crenshaw, 1997) and to foster social/professional communities (Schrum, 1993). As to the quality of on-line courses, Ridley (1995) found on-line courses at Christopher Newport University to be as rigorous or more rigorous than traditional courses. Students reported on-line courses to be "intensive" and "demanding." When compared to traditional courses, on-line courses had a significantly higher dropout rate. Furthermore, on-line courses tended to be more appealing to students with prior on-line learning experience.

Examples of traditional courses being offered electronically through various telecommunications mediums have been discussed by a number of writers (Romiszowski & de Haas, 1998; Schrum, 1992; Smith, 1989). The recent development of such on-line courses appears to be spurred by rapid advances in technology, the need for lifelong learning, and the growth of non-traditional students in the United States and elsewhere (Crossman, 1997; Romiszowski, 1997). In order to secure the education they desire, non-traditional students must often overcome a variety of barriers (Clabby, 1985; Golen, 1988; Mackenzie, 1994; Richter, 1984; Schmidt, 1997); many of these hindrances relate to concerns about time, distance, and financial matters (Schrum, 1995). On-line courses are viewed by some non-traditional students and educators as a potential solution to the barriers of time and distance (Schrum, 1995). With on-line courses, students are able learn at home or at the office, thus avoiding the time and expense associated with traveling to and from class.

With the rapid acceptance of the Internet as a viable and cost effective medium for delivering instruction, there is the possibility that barriers associated with learning over the Web may be overlooked, ignored, or minimized. It is possible that as on-line instructors overcome the traditional education barriers of time and distance, they will inadvertently create new barriers to education. While it is unclear at this time what these new barriers might be, some of the possibilities include access to the Internet, poor keyboarding skills, difficulty reading computer screens, lack of computer skills, lack of knowledge about

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the Internet/World-Wide-Web (Anderson, 1996; Reidelback, 1996), negative attitude towards the Internet (Maddux, 1996), costs (Freud, 1996), and differences in learning styles (Gibson, 1996; Hall, 1997). An understanding of these potential barriers is critical if educators/trainers are to provide a wide range of learners highly effective on-line instruction.

Research Questions

For the purpose of this investigation, three research questions were posed. They include:

1. What are some of the perceived barriers to taking courses on-line over the World-Wide-Web?
2. Is there a significant difference in perceived barriers with respect to age, gender, knowledge of computers, knowledge of the World-Wide-Web, and prior experience with on-line courses?
3. Is there a significant difference in perceived barriers with respect to career position and size of organization?

Methodology:

An Internet search was conducted to locate the universal resource locators (URL) of on-line faculty and staff e-mail directories for colleges listed in Peterson's 1997 Guide to Two Year Colleges. Thirty-eight colleges were randomly selected to serve as the sample group. A combined cover letter and 31-item questionnaire was electronically mailed to faculty and staff in the selected colleges. Respondents were also given instruction on how to return the questionnaire. Options included e-mail, fax, or the U.S. postal service. Fax and U.S. mail return options were offered to respondents desiring complete anonymity. Items on the questionnaire related to personal/occupational information, perceived knowledge of computers and the Internet, past experience with on-line courses, and perceived barriers to taking courses over the Internet.

Data from the questionnaires was entered into a statistical database from which descriptive and comparative statistics were generated. Descriptive statistics included frequency counts, percentages, and means scores for the various variables. Comparative statistics included the results Chi square and Annova tests. A series of Chi square tests were performed to test for significant differences in perceived barriers with respect to gender, geographical location, career position, and prior experience with on-line courses. Anova tests were used to test for significant differences in perceived barriers with respect to age, knowledge of computers, knowledge of the Internet/World-Wide-Web, and size of employing organization. The probability level for determining statistical significance was $p = .05$.

Results

Of the 1,146 surveys electronically delivered to employees at 38 community colleges, 764 were returned (66.666% return rate). Six hundred seventy-eight surveys (88.743%) were returned by e-mail, 63 (8.246%) by U.S. postal service, and 25 (3.272%) by fax. Respondents had a mean age of 45.228 years. Four hundred nineteen (54.842%) were female and 345 (45.157%) were male. Four hundred five (53.01%) were community college instructors, 201 (26.309%) were administrators, and the remaining 115 (15.052%) worked at various support positions. Thirty-seven (18.408%) administrators were high level administrators. Ninety-six (47.761%) were middle and 122 (60.697%) were lower level managers. Forty-three (5.628%) of the respondents had taken a course on-line and 15 (1.963%) had prior experience teaching courses over the Internet.

With respect to question one, What are some of the perceived barriers to taking courses on-line over the World-Wide-Web? the strongest perceived barriers appeared to be a preference for being with people over sitting at a computer, time to learn and do what is necessary to take a course on-line, and current knowledge of computers/the Internet. Table One shows mean ratings for the seven potential barriers examined in the study. Mean scores for access to computers (1.969) and access to the Internet (1.95) were nearly identical. The same was true for dislike for using computers (1.679) and an inability to learn with computers (1.674). Correlation coefficient for the two pairs were $r=.875$ and $r=.725$ respectively.

Other barriers noted by respondents included course availability, money, narrow bandwidth, lack of interest, lack of technical support, outdated computer equipment, lack of human/social contact, lack of

human interaction, a belief that technology was not suited for their subject area, a feeling that on-line learning is boring, and not being comfortable with new methods/technologies.

As to questions two and three of the study (Is there a significant difference in perceived barriers with respect to age, gender, knowledge of computers, knowledge of the World-Wide-Web, and prior experience with on-line courses? and Is there a significant difference in perceived barriers with respect to career position and size of organization?), several differences were discerned. *Chi-Square* tests results revealed a significance difference with respect to career position (see Table Two). Administrators perceived Internet access to be a significantly smaller barrier than did instructors and other workers (i.e., office support staff, maintenance workers, and grounds keepers). Instructors also perceived Internet access to be a significantly smaller barrier than did other workers. No significant differences were found with respect to gender, geographical location, or prior experience with on-line courses.

Table 1. Mean Rating For Perceived Barriers
N=764

Variables	Mean	SD
My preference for being with people over sitting at a computer	2.952	1.529
My limited time to learn and do what is necessary to take a course on-line	2.614	1.437
My current knowledge of computers/the Internet	2.036	.051
My level of access to computer equipment	1.969	1.412
My level of access to the Internet	1.95	1.41
My dislike for using computers	1.679	1.232
My inability to learn with a computer	1.674	1.167

Table 2. Chi-Square Test For Perceived Barrier Differences
N=764

Variable	Chi-Square	DF	P
Gender	7.679	4	.1041
Geographical location	13.194	12	.3551
Career position	20.427	8	.0088
Prior experience with on-line courses	2.43	4	.6572

Results of the Anova tests used to test for significant differences in perceived barriers and age, knowledge of computers, knowledge of the Internet/World-Wide-Web, and size of employing organization are shown in Table Three. Follow-up T-Tests revealed significant differences in perceived barriers with respect to age. Persons in their 40's, 50's, and 60's rated dislike for computers and limited time to learn and do what is necessary to take a course on-line as significantly greater barriers than did individuals under 30 years of age. Follow-up T-Tests also revealed significant differences among each of the seven perceived barriers with respect to knowledge of computers (see Table Five). The greatest differences were in the areas of limited time to learn and do what is necessary to take a course on-line, current knowledge of computers, and dislike for computers. Similar differences occurred across all seven barriers with respect to knowledge of the Internet/WWW (see Table 5). One notable exception was that perceived Internet access barrier differences among the levels Internet/WWW knowledge appeared less frequently. Individuals employed at organizations with 10,000 to 14,999 students rated the barrier dislike for computers a significantly greater barrier than did persons working at institutions enrolling 1,000 to 4,999 students.

Conclusions

A number of conclusions can be drawn from the results of the study. First, it appeared that none of the potential barriers were perceived to be major obstacles to learning on-line. On a 5-point scale only three of the barriers had a mean rating of 2.5 or higher. They included a preference for being with people over sitting at a computer (mean = 2.95), limited time to learn and do what is necessary to participate in an course (mean = 2.614), and current knowledge of computers/the Internet (mean = 2.036). This is not

altogether surprising since respondents in the study were all employed at institutions with posted e-mail directories on the Internet. Most respondents have sophisticated enough technical skills to take and return the survey instrument on-line. This may not be the case at other community colleges across the country. Secondly, one might conclude from low to moderate mean perceived barrier ratings, that if there are major barriers to learning on-line, they may have more to do with such things as the limited number of courses being offered on-line, limited resources to purchase up-to-date computers, narrow bandwidth, lack of interest, lack of technical support, and general discomfort with the Internet technologies than the seven barriers examined here. A number of these barriers have been noted by Anderson (1996) and Reidelback (1996).

A third conclusion that may be drawn from results of the study is that potential barriers represent greater obstacles to learning on-line for some persons than others. For example, a dislike for computers and the needed to learn and do what is necessary to take a course on-line are greater barriers for older individuals. Individuals over 30 years of age perceived such barriers as being significantly greater than did persons under 30. Dislike for computers also appears to be a greater barrier for persons working in larger organizations. Respondents employed at organizations with 10,000 to 14,999 students rated dislike for computers a significantly greater barrier than did persons employed at places enrolling 1,000 to 4,999 students. Gaining access to the Internet appears to be a greater barrier for individuals holding non-managerial jobs. Administrators in the study rated Internet access to be a significantly smaller barrier than did instructors and other workers.

Table 3. Annova Test For Perceived Barrier Differences
N=764

Variables	DF	Sum Squares	F Score	P
Age and dislike for computers barrier	4	13.25	2.41	.0479
Knowledge of computers and current knowledge of computers/Internet barrier	4	109.864	18.029	.0001
Knowledge of computers and access to computer equipment barrier.	4	43.581	6.089	.0001
Knowledge of computers and access to the Internet barrier.	4	34.395	4.815	.0008
Knowledge of computers and dislike for computers.	4	59.487	11.466	.0001
Knowledge of computers and preference for working with people barrier.	4	44.114	5.202	.0004
Knowledge of computers and inability to learn with computers barrier	4	36.574	7.791	.0001
Knowledge of computers and limited time barrier.	4	70.83	9.91	.0001
Knowledge of the Internet/WWW and knowledge of computers/Internet barrier.	4	100.325	16.13	.0001
Knowledge of the Internet/WWW and access to computer equipment barrier.	4	25.327	3.436	.0085
Knowledge of the Internet/WWW and access to the Internet barrier.	4	23.322	3.202	.0128
Knowledge of the Internet/WWW and dislike for computers.	4	28.716	5.298	.0003
Knowledge of the Internet/WWW and preference for working with people barrier.	4	47.206	5.571	.0002
Knowledge of the Internet/WWW and inability to learn with computers barrier	4	24.72	5.123	.0004
Knowledge of the Internet/WWW and limited time barrier	4	69.661	9.598	.0001
Size of employing institution and dislike for computers	4	15.854	2.897	0213

Table 4. Follow-Up T Tests For Knowledge Of Computers and Perceived Barrier Differences
N=764

Self-Rating On Knowledge of Internet/WWW Compared to Colleagues	Preference For Being With People Barrier	Limited Time To Learn Barrier	Current Knowledge of Computers Barrier	Access To Computer Equipment Barrier	Access To The Internet Barrier	Dislike For Computers Barrier	Inability To Learn With Computers Barrier
Much Less-Less							
Much Less-Same			*			*	
Much Less-Greater			*			*	
Much Less-Much Greater		*	*			*	
Less-Same		*	*	*		*	*
Less-Greater		*	*	*	*	*	*
Less-Much Greater	*	*	*	*	*	*	*
Same-Greater	*	*	*	*	*	*	
Same-Much Greater	*	*	*	*	*	*	*
Greater-Much Greater	*	*					

*Significant difference at .95%

Table 5. Follow-Up T Tests For Knowledge of Internet/WWW and Perceived Barrier Differences
N=764

Self-Rating On Knowledge of Internet/WWW Compared to Colleagues	Preference For Being With People Barrier	Limited Time To Learn Barrier	Current Knowledge of Computers Barrier	Access To Computer Equipment Barrier	Access To The Internet Barrier	Dislike For Computers Barrier	Inability To Learn With Computers Barrier
Much Less-Less							
Much Less-Same			*			*	
Much Less-Greater		*	*			*	
Much Less-Much Greater	*	*	*		*	*	*
Less-Same		*	*			*	
Less-Greater	*	*	*	*		*	*
Less-Much Greater	*	*	*	*	*	*	*
Same-Greater		*	*				
Same-Much Greater	*	*	*	*	*	*	*
Greater-Much Greater	*	*		*			*

*Significant difference at .95%

A fourth conclusion derived from the results is that knowledge of computers and the Internet widely affect how potential barriers to learning on-line are perceived. Perceived differences in all seven barriers were discerned with respect to knowledge of computers and the Internet. In general, individuals with greater knowledge of computers and the Internet tended to perceive each of the seven potential barriers to learning on-line as being significantly smaller than did persons with less computer and Internet knowledge. However, casual relationships between computer and Internet knowledge and potential barriers remain unclear. For example, does greater access to computer equipment and the Internet lead to greater computer and Internet knowledge? Does a preference for being with people cause individuals to avoid computers and thus limit their knowledge of computers and the Internet. Does a dislike for using computers result from a

lack of computer knowledge and/or their inability to learn with computers. These questions and others offer fertile ground for future studies.

The fifth and final conclusion of the study is that a strong relationship exists between access to computers and access to the Internet and a dislike for using computers and an inability to learn with computers. Correlation coefficients for the two respective sets of variables were r=.875 and r=.725. All respondents in the study had some access to computers and the Internet. It is likely that some individuals had greater access to computers than others (e.g., administrators versus other workers). Persons having greater access to computers most likely had greater access to the Internet. Individuals who have had difficulties learning with computers probably have acquired a greater dislike for computers than individuals who have experienced few difficulties. Furthermore, persons with a greater dislike for computers may be more likely to have had more difficulties in learning with computers than individuals who enjoy computers. They may also prefer being with people as opposed to sitting at a computer and feel less conformable with computer related technologies.

Discussion

The findings of this study have implications for trainers and educators interested in offering training modules and courses on-line as well as for organizations desiring their employees to engage in on-line learning. Increasing the computer and Internet knowledge of individuals over 30 years of age may be one of the most productive actions that can be taken to lessen perceived barriers by potential on-line learners. This might be accomplished through a combination of classroom training and technology mentoring. To dispel some perceptions of on-line learning as being highly impersonal and non-interactive, the training might demonstrate desktop video conferencing and other highly interactive technologies (e.g., shockwave) that learners may not be aware of. The training should also provide examples of how on-line instructors make use of humor, various media, and close student-instructor communications to make the instruction interesting and highly personal. Since some respondents reported availability on on-line courses as a barrier, the training might also teach participants how to locate on-line courses in their fields.

As with traditional barriers to adult learning, time appears to be an obstacle to taking courses over the Internet. Next to a preference for being with people, having the time to learn and do what is necessary to take a course on-line was judged to be the second strongest barrier to learning on-line. For individuals who have not grown up with computers, persons over thirty years of age, taking a course on-line may require a rather substantial up-front investment in learning time. It is best that this need is recognized and openly discussed. Institutions may want to adjust employee work schedules to accommodate this one time critical learning. They may also want to explore various types of incentives to encourage employees to "find the time" to bring themselves up-to-date technologically.

Dislike for computers appears to be a much greater barrier at larger institutions that it is for small institutions. Individuals employed at organization with 10,000 to 14,999 students rated "dislike for computers" a significantly greater barrier than did persons employed at institutions enrolling 1,000 to 4,999 students. Perhaps larger institutions have a longer history in the use of computers. Computers systems at these institutions may be older, larger, more cumbersome, more subject to breakdowns, and less user friendly than small systems used at smaller institutions. Outdated computer equipment and a lack of technical support were among the additional barriers noted by respondents. This being the case, more user friendly computer technologies may need to be made available at these institutions to encourage employees to take courses and training modules on-line.

Data in the study was drawn from 764 employees at 38 community colleges with access to the Internet. It is unlikely that these respondents or their institutions are representative of people and organizations in the general population with limited access to computers and/or the Internet. Furthermore, because many community colleges offer a variety of technical programs and some courses on-line, one might expect the computer technology skills of their employees to be somewhat greater than the general population. This being the case, the seven potential barriers examined in the study may be perceived by persons in the general population as being greater obstacles than what is reported here.

Further research is needed to explore other potential barriers to taking courses on-line. Potential barriers deserving study include course availability, money, narrow bandwidth, lack of interest, lack of technical support, outdated computer equipment, lack of human/social contact, lack of interaction, a belief that technology is not suited to some fields, a belief that on-line learning is boring, and discomfort with on-line teaching/learning methods and technologies. Factors affecting individuals' computer and Internet knowledge as well as a dislike for computers are additional areas in need of systematic investigation.

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E-Mail Mentoring: Boundary Spanning for the Distance Learner

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Boundary spanning and mentoring have each been heavily researched in organizational studies. This study suggests that the mentor can serve as a boundary spanner for distance learners. A study was conducted of university graduate students to determine the impact of e-mail mentoring on their perceptions of connectedness to the organization. The results indicate that the mentoring process enabled the learners to more accurately interpret the system and span the "transactional distance."

This paper explores the relationship between e-mail mentoring and boundary spanning. Qualitative studies have shown the benefits of mentoring in business and education. Sheehy (1995) researched people in midlife who were deepening friendships and exploring the satisfaction of mentoring. Wolf (1993) found that a female mentor-female mentee relationship was necessary to help women break through the glass ceiling. She concluded that once a mentorship was established, the female mentees had someone to interact and collaborate with, and were likely to explore more challenges. Summers-Ewing (1994) linked mentoring with either career success (as measured by salary and number of promotions) or early career progress. She also discovered that proteges had higher self-confidence and less job stress.

Cohen (1995) suggests that one of the behavioral functions of mentoring is that of information sharing. For the trainee in a global organization or student at an off-campus site, reliance on technology rather than face-to-face communication makes the receiving and processing of information a unique problem. Moore (1973), in describing his theory of transactional distance, defined distance as something more than just a geographic separation between educator and learner. He suggests that there is also a distance of understanding and perception, often creating many *mis*understandings and *mis*perceptions which must be overcome for planned learning to occur. Distance learners are, by definition, autonomous learners; Moore's theory emphasizes, however, how lonely an autonomous learner can be without a link, or connection to the learning center.

The authors of this paper address the valuable role of the adult educator as boundary spanner and mentor to the distance learner. Daft and Weick (1984) noted the need for people to "interpret what they have done, define what they have learned, solve the problem of what they should do next" (p.284). Distance learners, in particular, need a guide to enable them to interpret their new information accurately. The findings in Tushman and Scanlan's (1981) study of corporate managers suggested that some organizational members serve as boundary spanners. Their study revealed that managers often communicate across boundaries, thus enabling them to obtain relevant information on one side and disseminate it on the other. Tushman and Scanlan add that when the impact of idiosyncratic language and local conceptual frameworks in one organizational division or department can block the distribution of information across specializations, the manager can transcend this barrier.

We suggest that adult educators can serve as information gatherers and interpreters for adult learners, and can transcend communication barriers as the managers did in Tushman and Scanlan's (1981) study. Trainers and organization development professionals can "literally wade into the ocean of events that surround the organization and actively make sense of them" (Daft and Weick, p. 286).

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We suggest further that mentoring, through the use of e-mail, is an appropriate and effective means to overcome the communication problems inherent in transactional distance.

Theoretical Framework

This paper is grounded in the theoretical arenas of organizational culture, systems theory, mentoring and boundary spanning. An organizational culture is "supported by a pattern of basic assumptions developed by its members over time, thought to be valid and taught to new members as the correct way to perceive, think and feel" (Schein, 1990, p. 111). From systems theory comes the premise that the organization, as a system, tends toward a kind of equilibrium and tries to reduce dissonance and bring assumptions and beliefs into alignment with each other (Schein, 1990; Lewin, 1952). However, just as a system contains sub-systems, the organizational culture often develops sub-cultures, which, in turn, create dissonance and disharmony. Each sub-culture develops its own communication network and, over time, evolves into a unique subset of norms, assumptions and behaviors (Powell, 1997). Huber (1996) and Tushman and Scanlan (1981) support this systemic view of sub-cultures by noting that divisions or departments within an organization often have unique semantics which serve as a framework for a unique set of collective beliefs. Dissonant collective beliefs between divisions can result in a breakdown in the organization's information sharing system.

Mentoring can be defined as a one-to-one relationship between mentor (guide) and mentee (protégé) which can help mentees develop their personal, educational, or career potentials (Hubschman, 1996). Cohen's theory of mentoring suggests there are several levels of mentoring, the first which conveys through active, empathetic listening a genuine understanding and acceptance of the mentees' feelings. Its purpose is to create a psychological climate of trust which allows mentees to honestly share and reflect upon their personal experiences (positive and negative) as adult learners. The second emphasis is on information, which directly requests detailed information from and offers specific suggestions to mentees about their current plans and progress. A third mentoring focus is to assist mentees in considering alternative views and options while reaching their own decisions.

Another level is confrontation, where the mentor challenges the mentee to evaluate the need and capacity to change (Cohen, 1995). Mentors, argues Cohen, are essential to learners who have not obtained "sufficient informational reference points" (p.50), because they can help to interpret information. Their role allows them to provide feedback to determine if the learners are "anchored in realistic appraisal of the actual situation"(p.59).

The mentoring function appears similar to the boundary spanner, who must be able to understand the languages and conceptual frameworks of individuals outside of the division or department, in order to communicate effectively on both sides of the communication boundary. For the adult learner, the mentor who serves as boundary spanner is a link to the organization's resources and support system.

Research Questions

1. How does the use of e-mail in distance learning impact the learner's perception of the organization?
2. What effect does the e-mail mentor have on the learner's understanding of the organization's culture?

Methodology

This paper focuses on the findings of a study which was conducted at a large state university in Florida. The participants included 99 adult learners: sixteen males and 83 females from four graduate level research classes who were randomly assigned to mentored and neutral groups (Hubschman, 1996).

Each group was informed that, as part of the research study, they would be trained on the use of electronic mail (e-mail). It was stressed that the use of e-mail was voluntary, and would not affect the overall evaluation of the individual.

The researcher obtained mainframe accounts so that learners could send and receive e-mail immediately in the computer lab. A congratulatory letter was sent to all the first night. When the researcher demonstrated the fundamentals of logging onto the mainframe and receiving, replying, and composing e-mail by showing transparencies of actual screens and by giving out handouts of the screens for reference. That same night, learners were taken to the computer lab, where they practiced receiving messages from the instructor, replying to the instructor, and composing email messages to the instructor and peers. The researcher was available in the computer lab the next two weeks after each class, in case learners wanted extra instruction on using e-mail. The learners were also given instructions on how to access the mainframe computer from off-site, in case they wanted to use e-mail from their home or workplace.

Learners were randomly assigned to one of two groups. Those in the mentoring e-mail group received messages that attempted to establish a one-to-one relationship, give individualized advice, or challenge or motivate the mentee. Those in the neutral e-mail group received general information in an impersonal, generalized way (Hubschman, 1996). Those in the mentoring e-mail group were asked questions about their interests and goals, in order to convey more open communication between mentor and mentee. Each group was sent at least five researcher-initiated messages.

All e-mail received by the researcher was saved to disk for a qualitative analysis of themes, and coded quantitatively, as a "reply" (to previous mail) and "compose" (a new message).

Results

Many who replied to the e-mail post from the researcher wrote about completely different subjects than the titled message. Others responded to the titled message, and then proceeded to write about different concerns. A few learners wrote that it was easier to reply on this e-mail system than to compose a new e-mail message. Two t-tests were performed: one was to check for a significant difference between mentored and neutral groups in the number of responses sent to the researcher (Table 1), and the other was to check for a significant difference in the number of learner-initiated e-mail messages (Table 2). The mean of 6.89 responses from the mentored group, which consisted of 28 learners, was significantly different from the mean of 3.09 responses from the neutral group., which consisted of 22 learners. The mean of 3.11 composed messages from the mentored group, while greater than the composed messages mean of 1.77 from the neutral group, was not significantly different. This may have been due to the fact that some learners "replied" with new information rather than "composed" a new message.

Table 1

T-test of Total Responses by Responding Treatment Groups

Variable	N	M	SD	t-value	sig.
TOTAL RESPONSES					
Mentored	28	6.89	5.14	3.05	.004*
Neutral	22	3.09	3.13		

* $p < .05$

Table 2
T-test of Learner-Initiated Messages by Responding Treatment Groups

Variable	N	M	SD	t-value	sig.
TOTAL RESPONSES					
Mentored	28	3.11	3.14	1.65	.104
Neutral	22	1.77	2.37		

Mentored learners corresponded twice as much as did neutral learners, allowing them the opportunity to give and receive feedback on a number of academic and personal issues and to explore alternative views of organizational, departmental and academic concerns. The trust implicit in the mentoring relationship clearly encouraged a more frequent and deeper relationship. Learners who mentioned this deeper relationship in the qualitative component of the study described their feelings of "connectedness" to the course, the instructor and the institution. These findings suggest to us that mentors, in their role as boundary spanners, can enhance the confidence and self-esteem of the learner through serving as representatives of the system and thus enabling the learner to feel acknowledged and recognized by the system.

Implications

Although this study was conducted in a university setting, the mentoring relationship and boundary spanning studies were initiated and are grounded in the industrial workplace. With the advent of globalization, trainees are instructed through satellite and software. With the influx of telecommuting, employees who have replaced the traditional workplace with a home office, struggle with feelings of alienation and isolation from their organization's culture. This study suggests a new and vital role for the trainer, career development or organization development specialist: that of boundary spanner, who can, through the mentoring relationship, interpret the organizational climate for the distance employee.

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An Organizing Scheme for the Uses of Software Technology in HRD

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This review explores both research and popular literature for evidence of a previously published model, taxonomy or organizing scheme for computer software technology in HRD. It postulates that such a mechanism would be useful for helping both practitioners and researchers make informed decisions concerning computer technology. Since, no such model, taxonomy or organizing scheme was found during the literature search, the paper proposes an organizing scheme based on the ADDIE model of instructional development.

This literature review has several goals. First, to determine if a model, taxonomy or organizing scheme for computer software in HRD exists. Software technology is defined as computer software running on any level of computer hardware; mainframe, mini-computer or personal computer (PC). Discussion of the hardware used to run the various kinds of software is outside of the scope of this paper. Second, to identify the purpose and type of various software technologies used in accomplishing human resource development tasks and managing the human resource development process within organizations. The final goal of the paper is to propose an organizing scheme that classifies software technology according to its purpose and uses in HRD using the Analysis, Design, Development, Implementation, Evaluation process derived from instructional systems development (ISD) (HUMMRO, 1979) as the macro level classification mechanism.

Two trends converge to make this paper a timely contribution to HRD. The first trend is the call by Swanson (1995) and others for greater attention to developing a theoretical base for HRD and for aligning the actions of practitioners to improve organizational performance with that theoretical base. Second, as Arnold (1996) succinctly expressed it, the deployment and use of information technology (IT) within organizations continues unabated. At the intersection of these two trends stands the HRD practitioner and the HRD researcher. The practitioner wants tools and information, which will help him apply his expertise to the problems associated with increased technology introduction and use. The researcher needs taxonomic classifications as the first step in developing conceptual structures that can evolve into the theoretical base called for by Swanson.

Much of the research conducted over the past 3 decades has concentrated on the efficiency of computer-based training and associated learning delivery technologies. The time reductions and cost efficiencies of computer-based training (CBT) dominate the discussion when talking or writing about software technology in HRD. The new technologies refer to computer-based training (CBT) and computer assisted-instruction (CAI) in various forms. These include hypermedia and interactive multi-media (Ambron and Hooper, 1990; Fritz, 1992), distance learning, (Spikes, 1990; Thach and others 1993; Verduin and Clark, 1991), and interactive videodiscs, (Russ-Eft, 1994) as well as performance technology. This limited view obstructs the efforts of practitioners in making sense of the vast array of software choices and of researchers in building the structured and cohesive models necessary for understanding the phenomena.

A software technology organizing scheme addresses these concerns by expanding the practitioners' view from a focus on training to looking at performance improvement through the lens of a more comprehensive HRD model. It also provides researchers with a common vocabulary and set of definitions with which to begin the empirical testing necessary to theory development. As Finn (1953) wrote, "*Without a theory that produces hypotheses for research, there can be no expanding knowledge and technique. And without a constant attempt to assess practice so that the theoretical implications can be teased out, there can be no assurance that we will ever have a theory or that our practice will make sense. (pg. 6)*"

Frankfort-Nachmias and Nachmias (1992) list four types of theory that can be constructed:

1. Ad hoc classification systems which are arbitrary divisions into categories
2. Taxonomies which are categories based on empirical observation
3. Conceptual frameworks which are broad structures specifying relationships
4. Theoretical systems which combine taxonomies and conceptual frameworks.

This paper clearly fits the "Ad hoc classification system" description. It is a first step at creating the dialogue necessary for further theory development of software uses in HRD leading to

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a true taxonomy. Krathwohl, Bloom and Masia (1964) describe a true taxonomy as, "*a set of classifications that are ordered and arranged on the basis of a single principle or on the basis of a consistent set of principles. Such a true taxonomy may be tested by determining whether it is in agreement with empirical evidence and whether the way in which the classifications are ordered corresponds to a real order among the relevant phenomena. The taxonomy must be consistent with sound theoretical views available in the field. Where it is inconsistent, a way should be developed of demonstrating or determining which alternative is the most adequate one. Finally, a true taxonomy should be of value in pointing to phenomena yet to be discovered.*" This broad purpose of developing an ad hoc classification scheme leads to the following questions that framed the literature search.

- Does a model, taxonomy or organizing scheme for computer software technology in HRD currently exist?
- How are various software technologies used in accomplishing human resource development tasks and managing the human resource development process within organizations?
- What framework will best serve researchers in identifying the underlying concepts and constructs for the use of technology in the entire HRD (ADDIE-M) process?

Literature Review

The broad nature of this analysis prompts inclusion of nonresearch-based information drawn from practitioner publications and technology supplier literature, in addition to conceptual and case-based research literature. More than 120 journal articles, white papers, catalogs and company brochures were examined during the course of the study. In keeping with the primary aim of the study to identify and then provide a macro classification for the various technologies, no attempt was made to pursue any of the various categories in depth.

An initial literature search was conducted on the key words: performance technology; human performance technology; human resource development technology; human resource development software; and instructional technology, in an effort to determine if there was an existing classification scheme or taxonomy. The reference abstracts produced by this search were skimmed looking for discussion of models, taxonomies and organizing schemes. The following ten publications were reviewed: *Human Resource Development Quarterly, Training Magazine, Training and Development Journal, Performance Improvement, Performance Improvement Quarterly, Educational Technology Research and Development, Journal of Computer-Based Instruction and Journal of Educational Computing Research, Inside Technology Training and CBT Solutions.*

Once it was determined that no such scheme existed, articles containing the key words, software, information technology, and future of HRD were examined and an initial outline of possible categories was formed. This process continued iteratively, with expansions of the search into the literature of education, information technology (computer science), psychology, organizational development and career development. As the search of each discipline's literature led more deeply into in-depth discussion of the particular technologies rather than simply defining and classifying them, the search was shifted to another discipline.

After completion of a relatively well-developed categorization of the various types of software using the HRD process of *Analyze, Design, Develop, Implement and* Evaluate (Swanson, 1994) and establishing as yet unnamed subcategories the literature search was expanded to company brochures and industry white papers. This part of the literature search produced more concrete descriptions of the functionality of the various products and to find products that appeared to fit the categorization thus far. While it can be argued that industry white papers and company brochures are not "research", the speed of development, introduction and adoption of these software tools often outstrips the research community's ability to identify, categorize and assess their effectiveness. The examination of product literature and company white papers proved particularly valuable in completing the organizing scheme, since much of the research based in literature has concentrated on the Development and Implementation phases using computer-based training/instruction. The result of this final round of classifying and labeling was the organizing scheme presented next.

Results and Conclusions

The literature search found no model, taxonomy or organizing scheme which was based on a systematic HRD process and which sought to integrate the various types of software technology used in career development, organizational development and training. Consequently, the HRD Software Technology Organizing Scheme depicted in Diagram 1 was developed. The brace map, which is used for representing part-whole and part-subpart relationships, was selected as the mechanism to provide an overview of the concepts is depicted in *Figure 1*.

There were three levels used in the initial classification, ***Stage***, ***Purpose*** and ***Type***. Shown next are the definitions of each level in a hierarchy representing their level in the organizing scheme.

Stage is a bounded component element of the systematic human resource development process represented by the acronym ADDIE-M with Management depicted as an overarching concern throughout the process.

Purpose is the primary set of tasks or processes in HRD that the software assists the user to perform. Purpose is a gross distinction, since many programs could fit into multiple categories depending on where the arbitrary lines are drawn.

Type is a specific task, set of tasks or process in HRD that the software assists the user to perform.

Using this framework, the literature and example products were analyzed for logical groupings. For example, from the ***Analysis Stage***, *Learning Assessment* (a ***Purpose***) software enables or enhances the performance of tasks related to the measurement and assessment of knowledge, skills, abilities or attitudes of individual employees or groups of employees. Any software having these characteristics as its primary function would be grouped into that category. ***Type*** provided a greater degree of specificity for accomplishing HRD tasks or executing processes. For example, *Needs Assessment* software helps collect and analyze data to accurately identify the gaps between actual and desired performance at the thee levels of organizations, individual, process and organization (Swanson, 1994). **Table 1** shows ***Stage*** and ***Purpose***, including definition of each category within ***Purpose***.

Contribution to New Knowledge in HRD

Taxonomies, organizing schemes and frameworks are used to help both researchers and practitioners "make sense" of and make decisions about things within their field. A review of relevant literature failed to produce the kind of organizing scheme proposed here. Accordingly, this paper serves to initiate conversation about how software technology impacts HRD and about how we can begin organizing the current information and data, as well as beginning the search for new data.

Because this paper presents ideas not previously organized in this way, it raises more questions than it answers.

- Is the ADDIE-M process an appropriate model for the macro level of the framework or would another process or model be better?
- Which of the classification mechanisms would be most appropriate for software technology in HRD?
  - Teleologic based on a shared purpose (used in the proposed scheme)
  - Phylogenic based on a common root or origin
  - Phenetic based on observable similarities or differences
- What is the dividing line between Stage and Purpose and Type?
- How do we classify software that apparently fits in many or all of the classifications?

The next step in continuing research on this topic would be to establish a Delphi panel to more stringently examine the definitions and propose relationships between Stage and Purpose and Purpose and Type to create a true taxonomy.

Figure 1

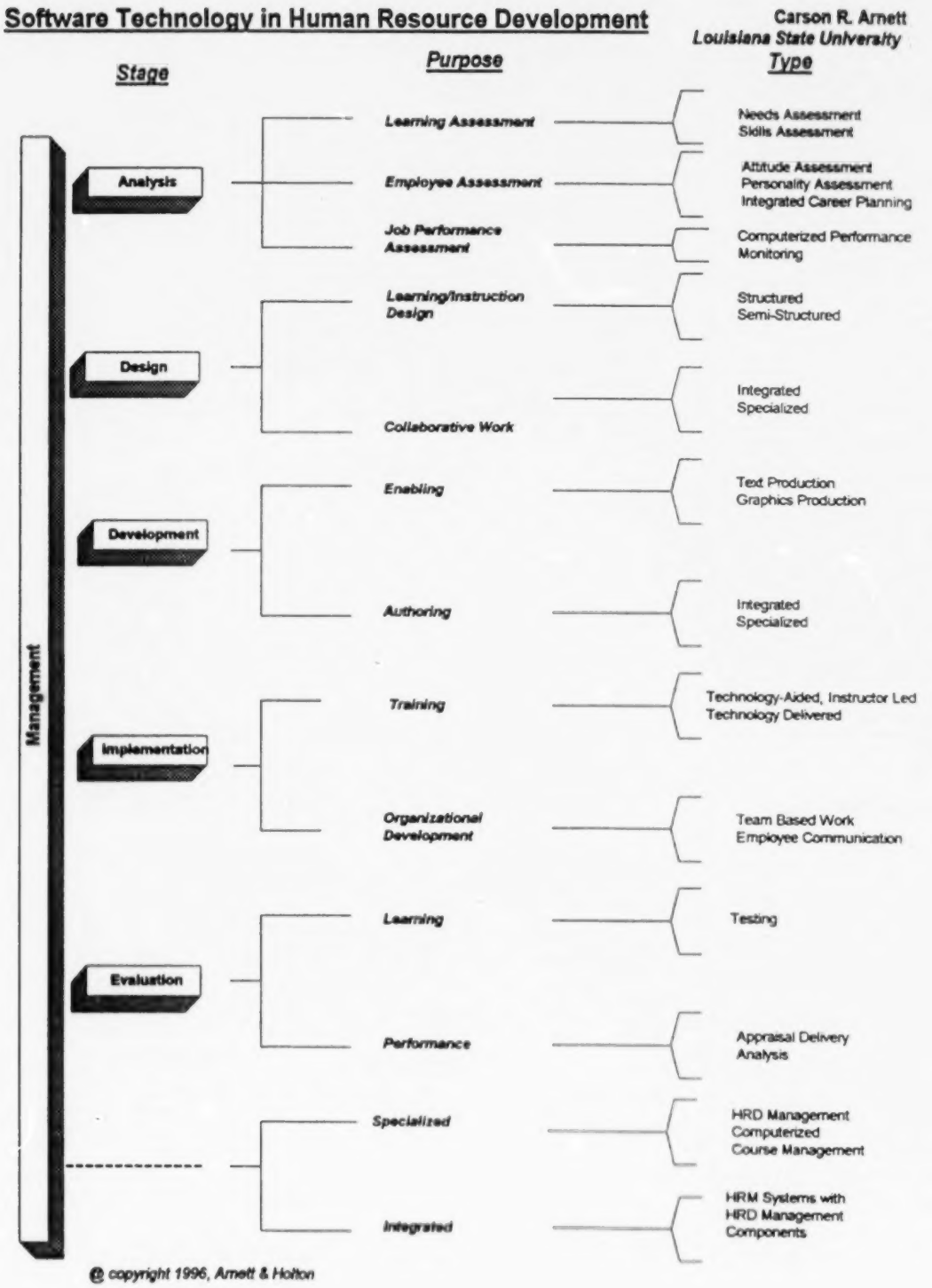

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Table 1

Stage	Purpose
Analysis	*Learning Assessment* Contains two subcategories of technology, needs assessment and skills assessment. Learning assessment measures knowledge and skills levels of employees and compiles them to facilitate diagnosis of organizational performance problems and desired versus actual knowledge, skills, and abilities measured against some pre-determined standard. *Employee Assessment* Technology to test and measure the employees attitudes, personality, learning style and assist the employee in developing a career plan with their goals aligned with the mission of the organization *Job Performance Assessment* Contains two subcategories of technology, computerized performance monitoring systems and human resource information systems. Tools in this category measure compliance with pre-determined standards while completing the tasks specified in the employee's job.
Design	*Learning/Instruction Design* Technology in this category provides the user with help in all phases of the instructional design process, except actual media production and presentation. Divided into two types, structured and unstructured with structured representing the more traditional ISD approach to learning design and unstructured representing the emerging hypermedia/learner controlled non-design of information presentation. *Collaborative Work* Forms the very essence of the use of technology, changing the not only the work itself, but our perception of what work is and how it is best accomplished. Collaborative work technology is divided into two sub-types, integrated and specialized, both of which exhibit the primary characteristics of group work in the electronic age, communication, collaboration and coordination, but differ significantly enough that they should be examined separately.
Development	*Enabling* Standard technologies which enable the creation of HRD interventions fall into two categories, text production and graphics production. Because these products are so familiar to even the most technology phobic, limited time and space will be devoted to them in this study. Word processing and presentation programs comprise this category. *Authoring* Authoring systems are computer software packages which allow non-programmers to create (program) sophisticated applications which present information, ask questions and judge answers, branch in response to either user control or point in the program and capture data about the user. They can be further subdivided into two broad categories, integrated and specialized.
Implementation	*Training* Encompasses the most widely understood and commercially prevalent implementations of technology in HRD. This type divides into three sub-types, technology-aided, instructor led and technology-delivered. *Organizational Development* Implementation of technology in HRD at the organization level subdivides into team-based work and employee communication. Team based work technology assists individuals and groups in the coordination of complex tasks involving a rich mixture of delegation, sequential signoffs. Technology assisted employee communication transcends time and distance, without the requirement for physical presence to accomplish the designated tasks and brings the full specrum of multimedia to bear in facilitating communication.
Evaluation	*Learning* Definitions and categorization within the domain of learning evaluation remain elusive. Shifting emphasis from content based instruction to individualized self-directed learning and building competency has produced confusion and contention causing a lag in development of specific, identifiable technology solutions in this area. *Performance* Performance evaluation technology in HRD subdivides into appraisal delivery and assistance and data analysis on individuals, groups and the enterprise itself.
Management	*Specialized* Software enables administration of the HRD specific tasks and processes. It is subdivided into two types, HRD Management and Computerized Course Management *Integrated* Software administers and controls the entire human resource function, such as hiring, benefits and compensation and includes, but includes a module which performs essentially the same functions as specialized HRD management software.

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Table 2

Purpose	*Type*
Learning Assessment	*Needs Assessment* software has as its core function, the accurate identification of gaps between the actual and desired performance at Swanson's (1994) three levels, organizational, process and individual. An example developed at San Diego State University is Needs Assessment Naturally, an electronic performance support tool that helps education and training professionals assess needs and generate integrated strategies.
	Skills Assessment software has as its core function, the accurate identification of an individual's capability to perform specific tasks or collections of tasks (job). An example developed by VFX Technologies, Inc, is Endeavor, which tests the user's skills in Novell and Microsoft networking products.
Employee Assessment	*Attitude Assessment* software measures an individual's relatively permanent way of feeling, thinking or behaving towards something or somebody. An example developed by Hilson Research, Inc. is Career Satisfaction Index, which measures satisfaction with career progress, supervisors and on the job stress.
	Personality Assessment software gathers and analyzes data for identifying individual personality differences and interpersonal styles. An example developed by Myers-Briggs is the computerized version of the Myers-Briggs Type Indicator instrument.
	Integrated Career Planning software assesses individuals based on competencies identified by supervisors and managers as being important to present and future job performance. Once the "state of competency" has been identified, the employee is guided through a development plan to achieve the desired competencies. An example developed by Conceptual Systems, Inc. is Assessing Strategic Competencies.
Job Performance Assessment	*Computerized Performance Monitoring* utilizes computer software, hardware and peripherals to measure, record, store sort and compile data on work-related activities. (Schleifen, Shell, 1992). An example is call-routing and monitoring software used by many large telephone based customer service operations, such as SABRE, the reservation subsidiary of American Airlines.
Learning/Instruction Design	*Structured* software generally follows the 9 step Instructional Systems Design (ISD) model popularized by Dick and Carey (1991). An example developed by Allen Communications is Designer's Edge, a performance support tool that walks designers through the process, capturing the required information in each phase.
	Semi-Structured software incorporates the latest advances in cognitive psychology and focuses more on the design aspects of computer-mediated instruction. An example developed at Utah State University is IDXelerator, which facilitates the development of instruction-centered courseware based on the latest theories in instructional design.
Collaborative Work	*Integrated* software provides a full range of tools and capabilities to allow groups of people to work in either synchronous or asynchronous environments accomplishing tasks and executing processes via computers. An example developed by IBM is Lotus Notes, which supports document sharing, collaborative editing, email, and group calendaring and scheduling.
	Specialized software provides a limited range of tools and capabilities to allow groups of people to work in either synchronous or asynchronous environments accomplishing specific tasks or executing a single process via computers. An example developed by Corel is Envoy, a document-publishing viewer that permits users to view and annotate documents without having the software that originally produced the document.
Enabling	*Text Production* software serves primarily to produce documents which communicate through the use of text and occasional graphics. An example developed by Microsoft is Word 7.0. Presentation Production software serves primarily to produce documents which communicate through the use of graphics and occasional text. An example developed by Microsoft is Power Point.
Authoring	*Integrated* authoring software enables nonprogrammers to create multimedia computer based instruction. An example developed by Macromedia Corporation is Authorware. Specialized authoring software assists in the creation and development of some component of the multimedia computer based instruction. There are packages in this category for graphics production and manipulation, sound, video, storyboarding and a host of other activities related to the production of multimedia computer-delivered training. An example developed by Adobe Systems, Inc. is Illustrator, a graphics package.

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Training

Technology Aided, Instructor-Led software transforms the traditional methods of instructional information presentation, such as books, blackboards and video by allowing the alteration and updating of the information and examples in real time. An example would be the use of Microsoft Powerpoint to illustrate the effects of changes in the mean and standard deviation on the normal curve.

Technology Delivered involves use of computer technology to present instructional transactions in any of Merrill's (1996) formats, text, demonstrate, compare, converse, explore.

Organizational Development

Team Based Work software enables accomplishment of a set of tasks or execution of a process by more than one individual. Software that supports such work is often called Groupware or Collaboration Software. An example developed by Novell Corporation is Groupwise, which supports document sharing, collaborative editing, email, and group calendaring and scheduling.

Employee Communication software facilitates the electronic interchange of messages, files, documents and media objects, such as sound. An example developed by Qualcomm, Inc. is Eudora, a stand-alone package for creating, reading, sorting and storing email.

Learning

Testing software assists in the creation, presentation, feedback, answer collection and reporting of results on test questions and test files (group of questions) used to measure knowledge, skills or attitudes. An example developed by Question Mark, Inc. is QuestionMark Interactive.

Performance

Appraisal Delivery software provides a mechanism for capturing the information generated in the dialogue between manager and worker about work goals and performance. An example developed by Compstar, Inc. is Appraiser Plus.

Data Collection software captures stores and sorts data relative to individual, process and organizational performance. An example developed by Microsoft Corporation is Access database software. Since this is a fundamental reason for the use of computers, this category of software has both a wide range and depth of products.

Data Analysis software supports the organization, description and analysis of information collected about individuals, processes and the organization. An example for two different kinds of data would be SAS for analyzing quantitative (mainly numerical) information and NuDIST for analyzing qualitative (words) data.

Specialized

HRD Management software enables administration of the HRD function in such tasks as, tracking activities, scheduling courses, determining costs. An example developed by Gyrus Systems is Training Wizard.

Computerized Course Management software controls and captures data about the process of computer-based training, including scheduling modules and courses and monitoring student progress. An example developed by Allen Communication is Manager's Edge.

Integrated

HRM Systems with HRD Management Components software administers and controls the entire human resource function, such as hiring, benefits and compensation and includes a module which performs essentially the same functions as specialized HRD management software. An example developed by Spectrum Corporation is HRVantage.

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